PATENT SPECIFICATION 1,080,405

DRAWINGS ATTACHED.

1,080,405

Date of Application and filing Complete Specification:
Aug. 12, 1965. *No. 34514/65.*

Application made in Luxembourg (No. 46789) on Aug. 18, 1964.

Complete Specification Published: Aug. 23, 1967.

Index at Acceptance:—G6 C8NX.

Int. Cl.:—G 21 c 3/34.

COMPLETE SPECIFICATION.

Support for the Core in a Nuclear Reactor.

We, SOCIETE ANGLO-BELGE VULCAIN, Société Anonyme, of 33, rue des Colonies, Brussels, Belgium, a Belgian Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to supports for the cores of nuclear reactors.

By support for the core we mean any device which supports and locates the fuel assemblies of the core.

The core support usually employed in a reactor is formed by an integral assembly of two or more perforated and parallel plates and of cross-pieces. This type of support has the drawback of having a considerable hydraulic resistance to the passage of any fluid used for removal of heat from the core and/or its moderation and/or its temperature regulation (which fluid will be called hereinafter "primary fluid"), owing to the small value of the ratio flow cross-section

$$\frac{\text{flow cross-section}}{\text{total cross-section}}$$

and also owing to the effect of local disturbances; moreover, such a support has a complex structure, is difficult to carry into practice, and is of a high cost of construction.

The present invention provides a support for the fuel assemblies of a core of a nuclear reactor, which support is formed by the assembly of a substantially rigid frame and a perforated plate serving to support and locate the said fuel assemblies. The frame and plate may be made integral with each other by any known means. The frame may be formed of an assembly of radial ribs, which may be perforated, connecting a central hub, intended to avoid a concentration of stress, with a circular or polygonal crown upon which the said plate is assembled and which allows the fixing of the support in the reactor vessel. The said crown may have a perforated annular dished extension extending towards the hub and welded to the lower faces of the radical ribs; this extension may be provided with openings in order to ensure a good distribution of the flow of the primary fluid. The frame must be sufficiently rigid to resist the various mechanical and thermal stresses to which it is exposed during the life of the reactor.

The perforated plate comprises a certain number of openings and is machined in such a manner as to ensure correct mounting of the fuel assemblies and to have a suitable profile for the passage of the primary fluid with a view to reducing the head losses and to provide a good distribution of the fluid flow at the bottom of the core.

The plate ensures the fixing and the centering of the fuel assemblies and has practically no function as a stiffing member; it is fixed upon the frame by any known means, such as bolts or riveting, permitting dismantling if desired. In the case of an accidental rupture it is indeed desirable to be able to replace it easily.

The proposed support for the core is therefore very rigid, in view of the structure of the frame whilst reducing the head losses in the primary fluid to a minimum; the ribs being comparatively thin and suitably profiled, do not particularly disturb the flow. Besides, as the plate does not make any substantial contribution to the mechanical resistance of the assembly, it may comprise openings of large sizes and/or additional openings, having a suitable profile for the passage of coolant fluid.

By comparison with the core supports usually employed, the support according to

[*Price* 4*s.* 6*d.*]

the present invention has the following advantages:

— reduction of the head losses associated with the passage of the primary fluid;
— a gain of space and a reduction of volume of the primary circuit and of its inventory of primary fluid, the cost of which is sometimes high;
— lower concentrations of mechanical stress, lower thermal stresses, and less dangerous incidence of these stresses upon the behaviour of the support;
— a simple and economical carrying into practice: reduced weight and machining, comparatively broad tolerances, and fewer welding points. The frame may be machined with relatively broad tolerances, because it does not serve to localise the fuel assemblies and only provides mechanical resistance.

An exemplary embodiment of the present invention is shown in the accompanying drawings in which:—

Figure 1 shows a cross-section of a fuel-assembly locating plate;

Figure 2 shows a cross-section of a rigid frame for assembly with the plate of Figure 1;

Figure 3 shows a cross-section of the core support formed by the assembly of the plate and frame;

Figure 4 shows a plan view of half of the plate; and

Figure 5 shows a plan view of half of the frame.

In the Figures the plate is shown by the reference numeral 1; it is provided with openings 2 and carries along its periphery a machined supporting element in the form of a crown 3 (Figure 1). This plate is provided with twelve radial grooves 4 connected with a circular central collar 5 (Figure 4).

The rigid frame 6 shown in the drawings has the form of a star; it is formed of twelve radial ribs 7 converging upon a central hub 8 and connecting this hub with a peripheral crown 9. Crown 9 is provided with an inwardly extending annular extension 10, which is dished having the form of a frustum of a cone. The extension 10 is welded to the lower faces of the radial ribs 7 and is provided with perforations 11 permitting the passage of primary fluid.

To form a core support assembly (Figure 3), the crown 3 of the plate 1 is fixed upon the crown 9 of the frame 6 by means of bolts; the ribs 7 are located in the grooves 4 whilst the collar 5 rests upon the hub 8.

The feet of the fuel assemblies engage the openings 2 of the plate 1, which serve to centre the said assemblies and to maintain them in a vertical position during the placing of the core in position.

The ribs 7 have recesses 12 in their upper edges at positions corresponding to those openings 2 that are intersected by grooves 4; these recesses substantially prevent obstruction of the primary fluid flow by the ribs.

WHAT WE CLAIM IS:—

1. A support for the fuel assemblies of a core of a nuclear reactor, which support is formed by the assembly of a substantially rigid frame and a perforated plate serving to support and locate the said fuel assemblies.

2. A support according to claim 1, in which the frame is formed of an assembly of radial ribs connecting a central hub to a peripheral crown.

3. A support according to claim 2, in which the radial ribs are perforated.

4. A support according to claim 2 or 3, in which the peripheral crown of the frame is provided with a perforated annular dished extension extending towards the hub and welded to the lower faces of the radial ribs.

5. A support for the fuel assemblies of a core of a nuclear reactor, substantially as herein described and illustrated in the accompanying drawings.

MARKS & CLERK,
Chartered Patent Agents.
Agents for the Applicants.

Abingdon: Printed for Her Majesty's Stationery Office, by Burgess & Son (Abingdon), Ltd.—1967.
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.

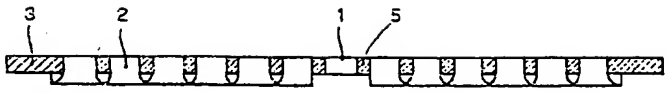


FIG. 1

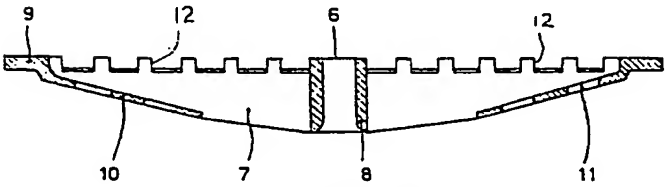


FIG. 2

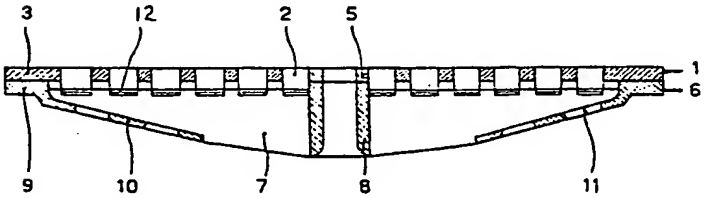


FIG. 3

1080405 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

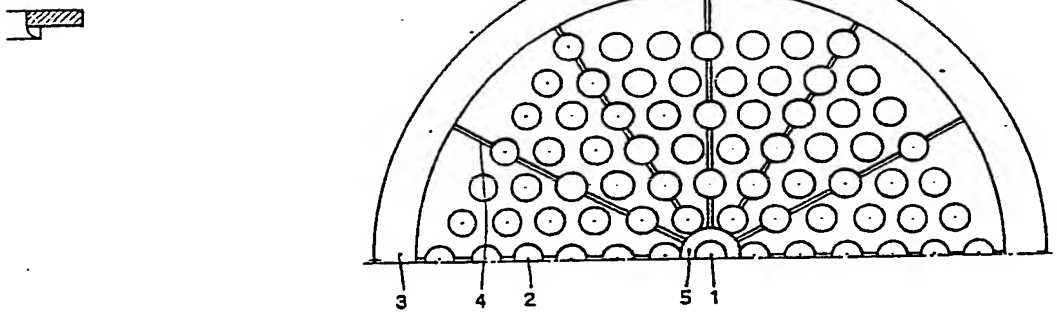
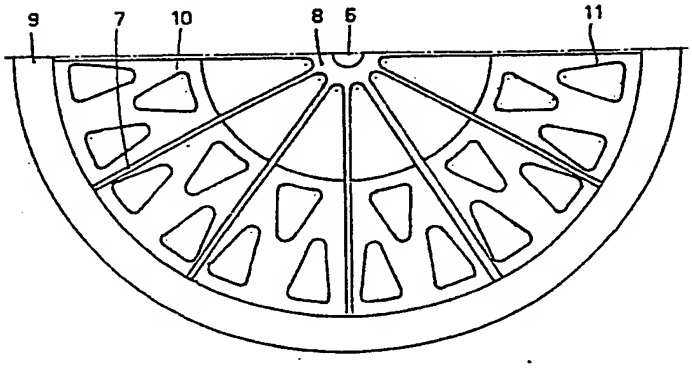


FIG. 4



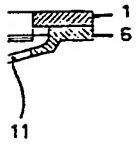


FIG. 5

1080405 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

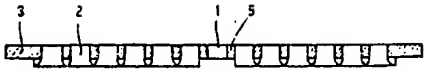


FIG. 1

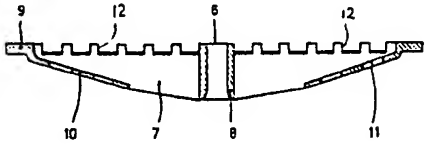


FIG. 2

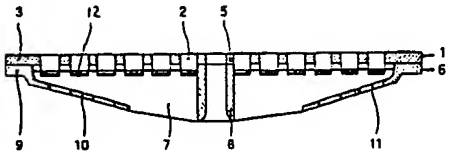


FIG. 3

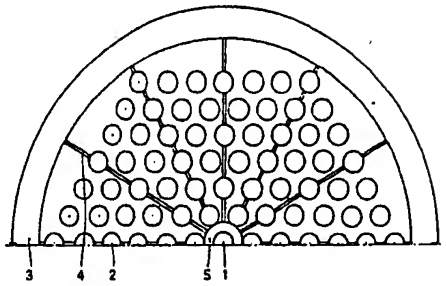


FIG. 4

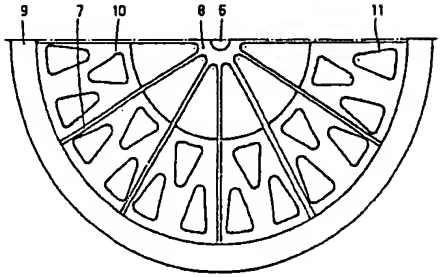


FIG. 5